

Lesson Plan

The Changing Coral Reef Community Game

FOCUS

Observe and track changes in the species composition on a coral reef as various factors and environmental influences affect the populations reef inhabitants.

FOCUS QUESTIONS

- What happens to the populations of sponges, corals and seaweeds on the coral reef over time?
- What factors affect the populations of sponges, corals and seaweeds over time?
- Why is recruitment important to the reef?
- What causes mortality in organisms?
- Is it possible for a biological community to change over time? What might cause a shift from one dominant species to another?

LEARNING OBJECTIVES

Students will:

- learn about the living requirements and ecology of three important sessile organisms that inhabit the coral reef: corals, sponges and seaweeds.
- chart the changes in the population of sponges, corals, and seaweeds over time as the coral reef community experiences environmental changes and other factors that affect the growth, mortality and recruitment of reef organisms.

GRADE LEVEL

4-6 (Life Science)

MATERIALS

- Coral Reef Organism card set
- Scenario card set
- Extra Organism card set

- Table and/or chair for plotting population curves
- Instructions

TEACHING TIME

45-60 minutes, depending upon the number of rounds the game is played and the length and depth of the discussion

SEATING ARRANGEMENT

Groups of 4-8 students seated around tables

MAXIMUM NUMBER OF STUDENTS

For discussion purposes, the entire group should be limited to no more than 30, but multiple games can be played in the classroom simultaneously

KEY WORDS

Organism, Population, Biological Community, Ecosystem, Dominant, Growth, Reproduction, Mortality, Recruitment, Sponges, Corals, Seaweeds (macro-algae)

BACKGROUND INFORMATION

The **biological community** is the living portion of the **ecosystem** and consists of **populations** of plants and animals that inhabit a particular area. The coral reef experiences environmental conditions that result in the growth, mortality and recruitment of reef organisms. The ability of a specific organism to survive and live successfully in a specific location depends upon many factors: food supply, space and living conditions as well as competition for food and space resources with other organisms.

Over time, the kinds and numbers of



organisms on a coral reef may stay basically the same or shifts may take place to favor one species or group of species at the expense of another group. This is especially true for corals and sponges that live attached to the seafloor or substrate because they must have a suitable amount of space in which to live and grow and that suitable space can be very limited in an area like the coral reef.

The **species composition** of a coral reef is determined by the kinds of organisms that form the reef community and their relative abundance to one another. When a species is present in great abundance in a particular place, it may be deemed the **dominant species**. Often, a community is named after the dominant species. In most cases, dominant species are plants, but they can also be corals, sponges, or other organisms.

When a coral reef experiences conditions that cause a shift toward more seaweeds and fewer corals over time, the species composition has changed. If the shift is significant enough, the characteristics and the dominant species for that community may also change. Such changes can affect other organisms at the reef. For example, if seaweeds become the new dominant species in an area, the fish and invertebrates that feed on seaweeds will be favored, possibly resulting in increases in populations of those species. Predators that feed on the seaweed eaters may also be favored. The way that organisms interact with one another also determines the kinds and numbers of species present in a particular area.

Changes in species composition are influenced by environmental conditions (both natural and human induced) and other factors like disease that affect the **growth**, **mortality** (death) and **recruitment** (addition of new individuals) of the reef inhabitants. For example, a coral reef can experience the loss

(mortality) of corals due to disease or severe environmental conditions. In time, other organisms like sponges may be recruited to the area and grow over the dead corals, changing the nature and characteristics of the biological community from one dominated by corals to one dominated by sponges.

Changes in the populations of organisms on the reef can be visualized by plotting population curves, which reflect the increases or decreases that took place because of certain environmental conditions or other factors. Population curves only measure presence or absence and do not reflect the size or maturity of the organism.

PREPARATION

Print out and cut the cards in the three sets of cards attached to this document: (Coral reef organisms, scenario and extra organism cards).

LEARNING PROCEDURE

The object of *The Changing Coral Reef Community Game* is to observe and track changes in the corals, sponges and seaweeds in a coral reef community through time. A set of 36 organism cards is used to represent the coral reef. Students apply scenarios to the corals, sponges and seaweeds on the coral reef that result in the addition or subtraction of individual, thus showing the changes in the species composition over time. Scenarios may be natural or human-induced. As the scenarios are applied, the students track the population changes in the sponges, corals and seaweeds and create population curves that show the fluctuations over time. Scenario cards describe events and relate concepts that involve mortality, growth, reproduction, recruitment, predation, disease, and species competition.



1. Shuffle coral reef organism cards (including blank page cards) and place them face up 6 rows of 6 cards each. These cards will represent the reef at a particular point in time. Before beginning the game, count the individuals at the reef of each species-- sponge, coral and seaweed. Record the totals in a table that can be viewed by everyone. The table should have spaces for the total numbers of sponges, corals and seaweeds at various time intervals. These counts will represent the "baseline population" from which all future comparisons will be made.

2. Four to 8 players can play at any one time. Shuffle scenario cards. Each player takes a turn drawing a scenario card and applying that scenario to the sponges, corals and seaweeds on the reef. If the scenario card describes the loss of a certain number of corals, sponges or seaweeds, the same number of cards for that kind of organism are turned over face down with their blank sides up to show that these organisms have died, creating an empty space for each organism lost in that scenario.

3. If the scenario card calls for the addition of new individuals to the community, the appropriate kind and number of cards from the extra organism set are placed on the empty spaces to represent the added sponges, corals or seaweeds. Only one organism per empty space unless otherwise state.

4. If the scenario card calls for the addition of new individuals, but there no empty spaces are available, no changes are applied to the reef community at that time. In some cases, scenarios may be applied that do not result in the loss or gain of individuals to the reef community.

Note: If the scenario card calls for the

addition or subtraction of individuals in a species greater than the number present at the reef, the highest number available is used. For example, If the scenario card calls for five sponges to die, but there are only 4 sponges at the reef, then 4 sponges die.

5. After each player plays a scenario card (one round), the group stops to tally up the number of individuals of each species and records that total in the table. Each round represents a 10-year period of time. Students can plot the number of individuals for each species for the next 50 years by completing five rounds. The game can be played through to any point that is desired.

6. Students use the totals for sponges, corals and seaweeds to create population curves that reflect the fluctuating populations of the three groups of organisms at 10-year intervals. After completing the population curves for sponges, corals and seaweeds, a discussion can begin to identify major shifts in the species composition and the factors that affected those changes and any consequences that accompany those changes (new species being attracted to the area because of changes, etc.). At the beginning of the game, the baseline community was dominated by corals, but is this still the case? If not, what has been the trend over time?

7. Students read copies of background materials. Teacher leads class discussion about biological communities, populations, etc., change in an area through time depending upon events and environmental conditions.

THE BRIDGE CONNECTION

Visit the [Bridge Web site](#), then click on *Ocean Science Topics*, select *Habitats*, select *Coastal Habitat*, then select *Coral Reefs*.



THE “ME” CONNECTION

Instruct students to read and summarize the information contained in the essay, [Name One Good Reason Why I should Care about Coral Reefs](#). The class can also discuss why people should care about coral reefs. To find the article, select *Coral Reefs* from the topic list and then select *Intro to Corals and More*. Students can also research other ways that reefs are important, including for medicine. The class can make a list of the reasons why corals are important to people.

EVALUATION

Ask students to review the scenario cards and determine whether each scenario describes recruitment, mortality or growth. Have students explain how mortality and recruitment affect populations of reef organisms and give examples of factors that affect coral, sponge and seaweed populations.

EXTENSIONS

Suggestion #1: Instruct students use the internet or local resources to identify a person who has observed the coral reef community in a certain area over time and interview them to find out what changes they have observed and why they think these changes took place. They should develop a set of questions in advance and then provide the questions and answers.

Suggestion #2: Instruct students to read and write an essay on the environmental conditions and other factors that have affected coral reefs in recent years. Specifically, what changes may have taken place due to increased coral disease and/or with the widespread mortality of the long-spined urchin, which in the past kept seaweed populations in check.

RESOURCES

This [NASA article](#) explains some of the threats facing coral reefs and the changes that have been observed in the last 25 years.

This [Ocean World Web site](#) provides student information about the biology of corals, coral reefs and the threats facing them.

NATIONAL SCIENCE EDUCATION STANDARDS

Content Standard C: Life Science

- Structure and Function of Living Systems
- Regulation and Behavior
- Populations and Ecosystems

FOR MORE INFORMATION

National Education Coordinator
NOAA Office of National Marine Sanctuaries
1305 East-West Highway, 11th floor
Silver Spring, MD 20910
301-713-3125 301-713-0404 (fax)
sanctuary.education@noaa.gov

ACKNOWLEDGEMENT

This lesson was developed for NOAA Office of National Marine Sanctuaries by Nancy Diersing, Education Specialist for Florida Keys National Marine Sanctuary. Dr. Niels Lindquist, University of North Carolina, graciously provided ideas and input on this lesson activity.

CREDIT

Permission is hereby granted for the reproduction, without alteration, of this lesson plan on the condition its source is acknowledged. When reproducing this lesson, please cite NOAA Office of National Marine Sanctuaries as the source, and provide the following URL for further information:
<http://sanctuaries.noaa.gov/education>

